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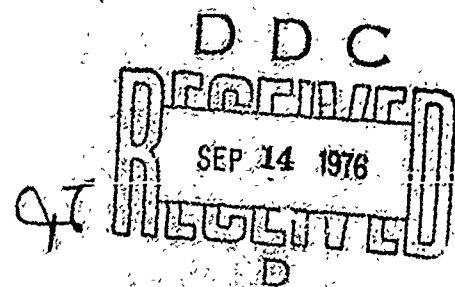
# USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

## VOLUME 38 C-130E IN-FLIGHT CREW NOISE

SEPTEMBER 1975

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AEROSPACE MEDICAL RESEARCH LABORATORY  
AEROSPACE MEDICAL DIVISION  
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FOR THE COMMANDER

  
HENNING E. VON GIER,  
Director  
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The C-130E is a USAF tactical long-range combat transport aircraft. This report provides measured data defining the bioacoustic environments at flight crew/passenger locations inside this aircraft during normal flight operations. Data are reported for 9 locations in a wide variety of physical and psychoacoustic measures: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived noise level, and limiting times for total daily exposure of personnel with and with-			

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out standard Air Force ear protectors. Refer to volume 1 of this handbook, "USAF Bioenvironmental Noise Data Handbook, Vol 1: Organization, Content and Application," AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc.

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## **PREFACE**

This report was prepared by the Biodynamic Environment Branch, Aerospace Medical Research Laboratory, under Project/Task 72310418, Measurement of Noise and Vibration Environments of Air Force Operations. Col Justus F. Rose, Jr., conducted the field measurements and performed the data analysis; Capt Nick Farinaeci prepared this report.

The authors acknowledge the efforts of Mr. John N. Cole who established the data analysis requirements and assisted in the preparation of this report, and Mr. Henry Mohlman and Mr. David Eilerman of the University of Dayton, who assisted in the mechanics of data processing.

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## INTRODUCTION

The C-130E is a USAF tactical long-range combat transport aircraft manufactured by the Lockheed Aircraft Corporation, Lockheed-Georgia Company. Power is provided by four T56-A-7A turboprop engines rated at 4,050 eshp at 12,820 rpm maximum take-off power. Each engine drives a Hamilton Standard four-blade constant-speed, 4.1 m diameter propeller through a 0.074 gear reduction. The engines are manufactured by the General Motors Corporation, Allison Division.

This volume provides measured data defining the bioacoustic environments produced inside the aircraft. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the C-130E aircraft.

This volume is one of a series published by the Aerospace Medical Research Laboratory (AMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and aerospace ground equipment. The far-field, community-type, noise data in the handbook describe the noise produced during *ground operations* of aircraft, aerospace ground equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. *Refer to Volume 1* (reference 1) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., in-flight/flight crew and passenger noise, near-field/ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published, and is available upon request from AMRL/BBE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of the updated index as it is generated.

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1. Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application*, AMRL-TR-75-50 (1), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

## **IN-FLIGHT NOISE**

### **MEASUREMENTS**

All noise measurements were made on-board a standard-configured C-130E aircraft during typical speed, altitude, and flight maneuver conditions. These levels describe the standard C-130E environments, but may not be representative of those levels encountered if the aircraft has been configured differently (e.g., major equipment or structural changes).

Acoustic measurements were made at various flight crew and passenger locations. Table 1 lists the measurement locations and test conditions as numeric/alphabetic designators which are used on the data pages. The designator 1/A means measurement location 1 and test condition A.

The microphone position was at ear level external to headgear in a region 0.2-0.3 meter from the head when an individual was present. At unoccupied locations, measurements were made at ear level throughout a volume where the head would normally be located. In both cases, the microphone was randomly moved throughout a spherical volume approximately 0.3 meter in diameter and the resultant samples analyzed using a 4- or 8- second integration time to obtain a power-averaged level, which effectively smooths out short-duration fluctuations and best describes the exposure.

Although the presence of a crew member or passenger at a measurement location affects the resultant sound field, the magnitude of such effects is generally small and not significant in determining exposure limits or voice communication capabilities. Consequently, no distinction is made in this report between occupied and unoccupied measurement locations.

### **RESULTS**

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the C-130E aircraft at the nine specified locations. This table includes the overall, 1/3 octave band, and octave band levels. From these data, C-weighted and A-weighted sound levels, maximum permissible time for one exposure per day (AFR 161-35) with and without standard Air Force ear protectors, preferred speech interference level, and perceived noise level are calculated and presented in Table 3. These measures are widely used to assess the effects of noise on personnel and their performance.



TABLE 1  
MEASUREMENT LOCATIONS AND TEST CONDITIONS

C-130E, Pope AFB, 21 Feb 1971  
Serial # 64-0495

LOCATION	POSITION	HEIGHT ABOVE DECK
1	Crew compartment	Seated Head Level
2	FS 280, WL 200, BL 0	1.5 Meters
3	FS 280, WL 200, BL 61L	1.5 Meters
4	FS 380, WL 200, BL 0	1.5 Meters
5	FS 380, WL 200, BL 61L	1.5 Meters
6	FS 550, WL 200, BL 0	1.5 Meters
7	FS 550, WL 200, BL 61L	1.5 Meters
8	FS 700, WL 200, BL 0	1.5 Meters
9	FS 700, WL 200, BL 61L	1.5 Meters

CONDITION	DESCRIPTION
A	Four engines — taxi power
B	Initial climb — gear and flaps retracted. Torque — variable Engine RPM — 100% Turbine Inlet Temperature (TIT) — 900°C Indicated Airspeed (KIAS) — 180 knots
C	High Cruise Torque — 13500 in.-lbs. Engine RPM — 100% Turbine Inlet Temperature (TIT) — 920°C True Airspeed (TAS) — 300 knots Altitude — 10.5M PA
D	Maximum Endurance Cruise Torque — 12600 in.-lbs. Engine RPM — 100% Turbine Inlet Temperature (TIT) — 880°C True Airspeed (TAS) — 290 knots Altitude — 10.5M PA
E	Descent Torque — 4000 in.-lbs. Engine RPM — 100% Turbine Inlet Temperature (TIT) — 580°C Indicated Airspeed (KIAS) — 250 knots Altitude — variable

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)														IDENTIFICATION:	
1/3 OCTAVE BAND															
2														OMEGA 3.2	
NOISE SOURCE/SUBJECT: ( OPERATION: )														TEST 71-001-104	
C-130E AIRCRAFT ( )														RUN 01	
INFLIGHT NOISE LEVELS ( )														02 JAN 75	
( )														PAGE F1	
LOCATION/CONDITION															
FREQ (HZ)	1/A	1/R	1/D	1/E	2/B	2/C	2/D	2/E	3/B	3/C	3/D	3/E	4/B	4/C	
25	77	86	84	84	81	83	84	82	80	85	83	83	77	79	
31.5	73	87	84	82	82	96	85	85	85	88	88	89	80	82	
40	73	80	81	80	77	81	81	80	81	87	87	86	76	83	
50	75	80	84	79	79	79	80	79	86	90	90	87	79	81	
63	95	106	110	104	101	101	101	98	109	115	114	102	100	102	
80	80	94	99	92	90	90	90	88	98	103	102	91	88	90	
100	78	76	79	75	82	84	83	82	82	86	87	84	86	83	
125	84	80	92	86	91	90	93	86	95	101	102	94	96	93	
160	83	77	84	78	84	87	87	85	86	91	92	87	87	88	
200	90	79	81	77	86	92	92	85	89	89	91	93	90	96	
250	86	77	78	78	82	90	89	86	84	88	88	87	85	90	
315	85	76	79	79	82	89	89	89	84	90	89	89	84	90	
400	85	77	79	79	82	88	90	90	82	89	89	89	84	89	
500	79	75	80	78	81	88	90	89	82	89	90	89	82	88	
630	76	78	80	76	73	88	90	88	79	88	89	83	80	87	
800	73	75	80	78	75	84	85	84	77	84	85	84	77	84	
1000	71	74	79	77	73	82	83	81	75	83	83	82	76	82	
1250	70	73	78	75	73	79	80	80	74	81	81	80	75	79	
1600	69	72	77	73	74	79	80	78	75	81	80	79	76	80	
2000	65	70	74	70	74	78	79	78	73	78	79	78	76	79	
2500	62	68	72	68	74	77	79	77	75	76	77	76	76	77	
3150	62	68	70	68	77	78	79	77	78	78	79	76	78	79	
4000	59	66	68	66	77	76	78	76	78	77	77	75	77	79	
5000	60	66	72	66	73	80	80	77	79	81	79	79	78	80	
6300	59	63	66	64	75	77	78	73	76	75	76	74	75	76	
8000	61	64	66	65	75	76	76	73	76	75	75	73	76	76	
10000	58	60	64	61	72	73	74	70	73	73	74	71	73	73	
OVERALL	98	106	111	104	102	103	104	101	109	115	115	105	102	104	

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

[illegible]

TABLE: MEASURED SOUND PRESSURE LEVEL (dB)									
1/3 OCTAVE BAND									
IDENTIFICATION:									
NOISE SOURCE/SUBJECT: ( OPERATION: )									
C-130E AIRCRAFT ( )									
INFLIGHT NOISE LEVELS ( )									
PAGE F3									
LOCATION/CONDITION									
FREQ (HZ)	8/B	8/C	8/D	8/E	9/B	9/C	9/D	9/E	
25	75	76	75	74	81	81	80	78	
31.5	79	83	83	82	82	86	84	84	
40	86	79	80	80	89	93	90	89	
50	92	81	83	81	96	99	97	93	
63	98	88	88	84	99	98	93	97	
80	98	85	84	81	90	90	88	88	
100	84	88	88	85	86	88	87	88	
125	89	90	92	88	92	90	91	88	
160	85	89	90	88	87	88	88	85	
200	83	91	89	88	83	89	88	85	
250	85	89	89	88	85	89	88	88	
315	86	92	91	90	86	92	90	90	
400	85	92	91	89	86	91	90	88	
500	85	91	91	89	84	91	90	88	
630	81	89	90	88	81	89	88	87	
800	76	84	83	82	76	85	83	81	
1000	74	83	82	80	75	84	82	80	
1250	72	80	80	78	72	80	79	78	
1600	74	79	79	78	73	80	78	77	
2000	71	79	78	77	73	79	78	76	
2500	70	76	76	76	72	76	75	75	
3150	72	77	76	75	72	77	75	75	
4000	71	75	74	73	72	75	73	72	
5000	73	75	75	72	73	75	74	71	
6300	70	72	70	69	69	71	70	68	
8000	70	71	70	68	70	71	69	67	
10000	67	69	67	66	67	69	67	64	
OVERALL	101	101	101	99	103	104	102	101	

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

[illegible]

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)														
2														
NOISE SOURCE/SUBJECT: ( OPERATION: ) IDENTIFICATION:														
C-130E AIRCRAFT ( ) OMEGA 3.2														
INFLIGHT NOISE LEVELS ( ) TEST 71-001-104														
( ) RUN 02														
( ) 02 JAN 75														
( ) PAGE J2														
LOCATION/CONDITION														
FREQ (HZ)	4/D	4/E	5/B	5/C	5/D	5/E	6/B	6/C	6/D	6/E	7/B	7/C	7/D	7/E
31.5	85	83	85	88	89	88	86	88	88	87	87	90	90	87
63	99	90	110	110	110	104	100	101	98	87	104	105	108	100
125	95	90	99	101	103	92	94	99	94	93	97	98	95	95
250	96	93	98	101	98	94	91	96	95	94	92	95	96	94
500	94	93	87	93	93	93	88	95	95	93	90	95	94	94
1000	87	85	84	88	87	85	79	87	86	85	79	88	87	84
2000	83	81	84	86	85	81	78	83	83	82	78	84	83	81
4000	83	81	85	86	85	80	80	83	82	81	80	83	82	81
8000	79	78	81	82	80	76	78	79	79	77	78	79	78	76
OVERALL	103	98	111	111	111	105	102	104	102	99	105	107	109	103



TABLE: MEASURES OF HUMAN NOISE EXPOSURE														IDENTIFICATION	
3															
NOISE SOURCE/SUBJECT: ( OPERATION: )														OMEGA 3.2	
C-130E AIRCRAFT ( )														TEST 71-001-104	
INFLIGHT NOISE LEVELS ( )														RUN 01	
( )														02 JAN 75	
( )														PAGE H1	
LOCATION/CONDITION															
1/A	1/B	1/D	1/E	2/B	2/C	2/D	2/E	3/B	3/C	3/D	3/E	4/B	4/C		
HAZARD/PROTECTION															
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DB) AT EAR															
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DB) AT EAR															
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)															
NO PROTECTION															
97	105	110	103	102	103	103	100	109	114	114	104	102	104		
OASLC															
87	85	90	86	89	94	95	94	91	96	96	94	90	94		
T	285	404	170	339	202	85	71	85	143	60	85	170	85		
MINIMUM QPL EAR MUFFS															
74	80	85	78	77	79	79	76	84	90	89	80	78	80		
OASLA*															
T	960	404	960	960	960	960	960	480	170	202	960	960	960		
V-31R EAR PLUGS															
66	68	72	66	66	71	72	71	71	77	77	72	68	72		
OASLA*															
T	960	960	960	960	960	960	960	960	960	960	960	960	960		
FLENTS EAR PLUGS															
67	69	74	68	68	72	73	71	73	79	78	72	69	73		
OASLA*															
T	960	960	960	960	960	960	960	960	960	960	960	960	960		
H-157 IN-FLIGHT COMMUNICATION UNIT															
76	80	85	78	78	80	80	77	84	90	89	81	79	82		
CASLA*															
T	960	500	404	960	960	960	960	480	170	202	807	960	679		
COMMUNICATION															
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)															
78	79	83	80	81	87	89	88	82	88	88	87	83	88		
PSIL															
ANNOYANCE															
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)															
TONE CORRECTION (C IN DB)															
101	105	110	105	107	109	110	107	111	116	116	110	107	110		
PNLT															
C	1	1	2	1	1	1	1	2	2	2	2	2	1		
* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.															

\* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.



TABLE: MEASURES OF HUMAN NOISE EXPOSURE														IDENTIFICATION:	
3															
NOISE SOURCE/SUBJECT: ( OPERATION: )														OMEGA 3.2	
C-130E AIRCRAFT ( )														TEST 71-001-104	
INFLIGHT NOISE LEVELS ( )														RUN 02	
C-130E AIRCRAFT ( )														02 JAN 75	
INFLIGHT NOISE LEVELS ( )														PAGE H2	
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LOCATION/CONDITION															
4/D	4/E	5/B	5/C	5/D	5/E	6/B	6/C	6/D	6/E	7/B	7/C	7/D	7/E		
HAZARD/PROTECTION															
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DB) AT EAR															
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DB) AT EAR															
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)															
NO PROTECTION															
OASLC	102	98	110	111	110	105	101	104	102	99	104	106	108	103	
OASLA	94	93	94	96	96	93	89	95	95	94	91	95	95	94	
T	85	101	85	60	60	101	202	71	71	85	143	71	71	85	
MINIMUM QPL EAR MUFFS															
OASLA*	79	75	86	87	87	80	77	81	78	76	80	82	84	79	
T	960	960	339	285	285	960	960	807	960	960	960	679	480	960	
V-51R EAR PLUGS															
OASLA*	72	70	73	75	75	72	67	73	72	71	70	73	74	71	
T	960	960	960	960	960	960	960	960	960	960	960	960	960	960	
FLENTS EAR PLUGS															
OASLA*	73	71	75	77	76	72	68	73	73	71	71	74	75	72	
T	960	960	960	950	960	960	960	960	960	960	960	960	960	960	
H-157 IN-FLIGHT COMMUNICATION UNIT															
OASLA*	80	77	86	87	87	81	78	82	80	78	81	83	84	80	
T	960	960	339	285	285	807	960	679	960	960	807	571	480	960	
COMMUNICATION															
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)															
PSIL	88	86	85	89	89	86	82	89	88	87	82	89	88	86	
ANNOUNCE															
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)															
TONE CORRECTION (C IN DB)															
PNLT	109	107	113	115	115	109	106	110	109	108	108	111	111	108	
C	1	1	2	2	2	1	1	1	1	1	1	1	0	1	
* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.															

\* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

